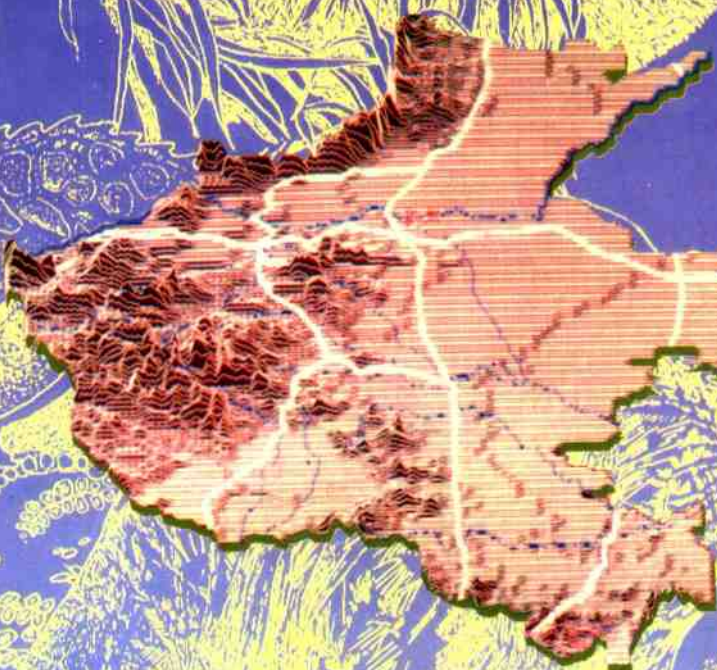


谨将此书献给第三十届国际地质大会
Dedicated to the 30th International
Geological Congress



河南地质矿产与环境文集

CONTRIBUTIONS TO GEOLOGY, MINERAL RESOURCES
AND ENVIRONMENT OF HENAN PROVINCE



中国环境科学出版社

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内 容 简 介

本书是为了向第三十届国际地质大会献礼而编撰的论文专集。书中收入了河南省地矿行业 90 年代以来比较优秀的地质矿产、水资源和环境地质方面的学术论文 44 篇,另收入介绍河南省境内供三十届国际地质大会野外考察的三条路线专文 3 篇。各文文后附有详细摘要的英文稿。本书作者大多是科研生产和野外勘查第一线的某学科方面有所专长的地矿工作者。书中各文基本反映了近年来河南省地质矿产主要方面的最新科研成果与学术水平,其显著特点是包含有丰富的第一手资料,特别是对于金、钼矿床的勘查与选矿方面,具有颇高的研究价值和实用价值。本书对从事地质矿产科研、生产和勘查找矿的科技人员以及地质院校师生,均有重要的参考价值;对地质矿产的国际学术交流,本书也是一本有价值的参考文献。

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序 言

河南省位于中国东部的中枢,别称“中原”,现有面积 16.7 万 km^2 ,人口 9000 余万,首府郑州。因处于北亚热带和暖温带之交,地跨“河、淮、江、海”四大水系,在古代地沃水丰,所以成为中华民族文明的发祥地之一。河南省的历史可上溯至公元前 6 000 年的裴李岗文化。被尊为中华民族始祖的伏羲和炎黄二帝,其主要活动范围即在河南及其邻区的黄河冲积扇。从公元前 2 100 余年治理黄河水患的大禹起,整部中华民族的文明史,莫不与黄河的决溢、迁徙和黄河冲积扇的发育息息相关。对于探索近、现代地质作用和人类历史进程的关系而言,河南是一个罕见的典型例证。

河南在纬向上位于东秦岭—大别山造山带转折部,在经向上处于华北与扬子两大古板块拼合区。从太古代至第四纪地层发育齐全,岩浆活动频繁,地质构造演化复杂而壮观。嵩山地区的前寒武纪“地质博物馆”名闻遐迩,豫西白垩纪红层中恐龙蛋化石密集产出的奇迹声震天下。河南的内生与外生矿产资源亦颇丰,迄今共发现矿产 132 种。其中花岗-绿岩型和构造蚀变岩型金矿床、斑岩型钼矿床、沿板块缝合带分布的蓝晶石族高铝三石矿床、古生代沉积盆地的铝土矿和煤矿床、新生代盆地的天然碱和石油、天然气等,在全国均具典型意义。栾川钼矿为世界级超大型矿床,小秦岭金矿是中国第二大岩金基地,平顶山、焦作、永城等煤田对中国中、东部工业发展具有战略意义。河南既是地质科研的理想基地,又不啻为矿业界人士的乐土。

河南省 1923 年 10 月创建河南地质调查所,1957 年 2 月设立河南省地质局,1962 年 12 月组建河南省地质学会,1988 年 12 月成立河南省地质矿产厅。河南省地质勘查行业现有职工近 2 万人,其中工程技术人员 4 000 余名,拥有一流的地质勘查技术。我厅试验成功,并已推广应用的超痕量金、铂、钯测试分析技术;地球化学探查金矿技术;堆淋法提金和无氰提金技术;科学调控浅层地下水与土壤水治理旱、涝、盐、碱技术;贯通式气动潜孔锤反循环钻进技术等,堪称当代地质科学之前沿,在中国地质事业和矿业的发展中起了重大推动作用。1980 年以来,河南省地质科技成果荣获国家级奖励的有 6 项,省部级奖励的近 400 项。经数十年地质勘查,在全省共探明矿产地 860 余处,矿产资源潜在价值 2 200 亿美元。河南省的煤、金、钼、铝、耐火粘土、油气等矿产品产量稳居国内前列,矿业现价年产值达 20 亿美元以上,居中国各省间第四位;矿业与后续产业年产值之和达 80 余亿美元,占全年全省工业总产值的 27%。地质工作者对河南省的科技进步和经济发展做出了不可磨灭的贡献。

河南省地质科技工作者将怀着激动而崇敬的心情参加第三十届国际地质大会,与来自四海的地质学界人士相聚,学习世界先进的地学理论与地质勘查技术,同时也奉上自己的研究心得与同仁交流。这本《河南地质矿产与环境文集》,反映了我省 90 年代地质科研与勘查的最新

成果,作为献礼著作呈献给国际地质大会。该《文集》既可展中原地学精英的风貌,又可视为探寻中州大地奥秘之路上的一块阶石,供后来者攀登时踏蹴。河南省地学工作者真诚地愿和世界同仁进行多种形式的交流与合作,同抒抱负,共展宏图,在本世纪末和 21 世纪初,促使地质科学走向新的辉煌。

河南省地质矿产厅厅长



1996 年 3 月 20 日

PREFACE

Henan Province, or called "Central Plains", is situated at the centre of eastern China, covering an area of 167,000km² and having a population of more than 90 million, with Zhengzhou as its capital. Located at the junction between the northern subtropical zone and warm temperate zone and extending across four main water systems of China (the Yellow River, the Huaihe River, the Yangtze River and the Haihe River.), it has a vast expanse of fertile land and once had plenty of water resources in ancient times, thus it's known as one of the birth-places of Chian's civilization.

The history of the province dates back to the Peiligang Culture (6,000 B. C.). Emperors Fuxi, Yan and Huang, respectfully called the three earliest ancestors of the Chinese nation, lived mainly on the alluvial fan of the Yellow River in Henan and its adjacent areas. The whole recorded history of the Chinese nation, beginning from Yu who was the founder of the Xia Dynasty (c. 21st-16th century B. C.) and prevented floods by harnessing the Yellow River, has closely related to the overflow and diversion of the Yellow River, the breaching of its dyke and the development of its alluvial fan. Henan is a typical region for studying the relationship between recent geological processes and the progress of human history.

Tectonically, Henan Province lies latitudinally at the hinge of the eastern Qinling Mountains-Dabie Mountains orogenic belts and longitudinally in the amalgamated zone between the North China and Yangtze paleoplates. It is characterized by the development of a complete set of strata from the Archaean to Quaternary, frequent magmatism, complicated and magnificent geological and tectonic evolution. The Precambrian "geological museum" in the Songshan Mountain area of the province is well-known far and near and the occurrence of dense fossil dinosaur eggs in the Cretaceous red beds of western Henan is indeed a spectacle in the world. Endogenetic and exogenetic mineral species so far discovered in Henan amount to 132, among which the gold deposits of granite-greenstone type and tectonic alteration type, the porphyry molybdenum deposits, the high-Al kyanite, andalusite and sillimanite deposits distributed along plate sutures, the bauxite and coal deposits in Paleozoic sedimentary basins, and the trona, oil and gas deposits in Cenozoic basins are all of typical significance nationwide. The Luanchuan molybdenum deposits constitute a superlarge ore field famous in the world; the Xiaoqinling gold ore field is the second largest one of vein gold type in China; and the Pingdingshan, Jiaozuo, Yongcheng and other coal fields are of strategic importance to the development of industries in central and eastern China. Therefore, Henan Province is not only an ideal area for geological scientific research, but a paradise for specialists of mining industry.

Henan Province established the Henan Geological Survey in Oct. ,1923,the Henan Bureau of Geology in Feb. ,1957,the Geological Society of Henan in Dec. ,1962,and the Department of Geology and Mineral Resources of Henan Province in Dec. ,1988. In the trade of geological exploration of Henan there are nearly 20,000 employees,of which more than 4,000 are engineering and technical personnel who have mastered first-class techniques for geological exploration. The techniques for analyzing ultratrace gold,platinum and palladium,for geochemical prospecting of gold deposits,for extracting gold by dump-leaching or cyanideless processing methods,for scientific regulation of shallow groundwater and soil water to control drought,waterlogging and salinization,and for pneumatic reverse circulation drilling with hollow-through down-the-hole hammer have played an important role in promoting the development of the geological work and mining industry in China. Since 1980,geologists of Henan Province have been awarded 6 state prizes and nearly 400 provincial or ministerial prizes for their geological scientific and technological achievements. Through scores of years of geological and mineral exploration,860 mineral deposits with a total potential value of US \$ 220 billion have been discovered within the province. The productions of coal,gold,molybdenum,aluminium,refractory clay,oil and gas of Henan occupy leading positions in China. The annual output value of Henan's mining industry is over US \$ 2 billion(in terms of present price),ranking fourth among the provinces and autonomous regions in China. The total of annual output values of mining and its related industries exceeds US \$ 8 billion,accounting for 27% of the yearly gross value of industrial output of the whole province. Geological workers have made great contributions to the scientific and technological progress and economic growth of Henan Province.

Geologists of Henan will attend,with reverence and excitement,the 30th International Geological Congress,have a get-together with friends of the geological community from all over the world,study the world's advanced geological theories and exploration techniques,submit their research results and exchange academic ideas with their colleagues from China and abroad. The present book,entitled *Contributions to Geology,Mineral Resources and Environment of Henan Province*,reflects the latest achievements in geological scientific research and exploration of the province in the 1990s,and will be submitted to the Congress. It not only deals with the unremitting efforts made in earth sciences by prominent geologists of the province,but serves as a tool for uncovering of the geological mysteries of the vast land of Henan. Geological scientists of Henan sincerely wish to make exchanges and cooperations in various forms with their colleagues from all over the world,and endeavour to promote a new prosperity of geoscience at the turn of the century.

前 言

河南省位于我国中部,地处黄河中下游,省境大部在黄河以南,故得“河南”省名。河南是我国古代文明发祥地之一,远在100万年前就有古人类在这里生息繁衍。七八千年前的裴李岗文化时期,这里就产生了农业、畜牧业和制陶等手工业。河南因古为豫州之地,故简称“豫”。豫州居九州之中部,故又有“中州”、“中原”之称。河南地理上位于北纬 $31^{\circ}23'$ ~ $36^{\circ}22'$,东经 $110^{\circ}21'$ ~ $116^{\circ}39'$ 之间,东西长580km,南北宽530km,面积16.7万 km^2 。人口9027万。河南气候跨暖温带和北亚热带,属大陆性季风气候区。光照充足,雨量适中,四季分明。年降水量从北到南大致在600~1000mm之间。河南地势西高东低。北、西、南三面有大行山、伏牛山、桐柏山、大别山环抱。太行山、伏牛山地一般海拔1000m以上。灵宝县境的老鸦岔是全省最高点,海拔2413.8m。东部为冲积成因的豫东平原,是华北大平原的组成部分,海拔100m以下。

河南在地质矿产上具有南北地层荟萃、多期构造叠覆、岩浆活动频繁、成矿条件优越、矿产资源丰富的特点。河南是我国矿产资源的大省(详见河南省地质矿产图)。以矿种而言,目前世界上已被利用的160多个矿种中,河南已发现132种,已被开发利用的达90多种。其中的钼、天然碱、蓝石棉、珍珠岩、蓝晶石、铸型用砂等6种矿产,储量居全国第一位。煤炭、石油、天然气、铝、金、银等是河南的优势矿产资源,储量位居全国前列。非金属矿产的水泥原料、耐火粘土、花岗石、大理石、玉石类和岩盐等也极为丰富,具有巨大的开发利用前景。据统计,河南有50种矿产居全国前十位,居全国前三位的也有16种之多。河南的年天然地表水资源约为313亿 m^3 ,地下水资源多年平均总量约为204亿 m^3 。目前,河南已有矿产地2300余处,国有大中型矿山企业250多家,乡镇矿山企业4600多家,采掘能力和开发利用已初具规模。河南已成为全国重要的能源、有色金属、贵金属和非金属原材料生产基地之一。目前河南已有30余种矿产品出口到东南亚、日本、欧美等30多个国家和地区。

第三十届国际地质大会是一次国际地质界的奥林匹克盛会。为了介绍河南省地质矿产概况,展示本省90年代以来地质科研和地质勘查的最新成果,反映本省地质科技的发展水平,开展国际学术交流,促进改革开放,振兴河南经济。河南省地质矿产厅、地矿部河南地质矿产勘查开发局和河南省地质学会决定出版《河南地质矿产与环境文集》,并以此献给在北京隆重召开的第三十届国际地质大会。

《文集》计刊登河南地质矿产与环境方面的学术论文44篇,地质旅行路线指南3篇。每篇文章的后部,附有详细摘要的英文稿。全书分为6篇,约50万字。第1篇:基础地质,包括岩石、地球化学、地层、沉积学、岩相古地理、古生物学、地质构造等学科的论文13篇;第2篇:矿床地质,包括金、银、铝、铅锌、蓝晶石、砂线石、红柱石、煤层气等矿床学术论文8篇;第3篇:勘查技术,包括钻探、化验、物探、构造形迹的数理演绎与应用、爆破技术等论文10篇;第4篇:矿产开发,包括金矿的选矿与回收利用,玉石和煤矸石的开发利用等论文6篇;第5篇:水资源与环境地质,包括水资源形势分析与开发利用,黄河防洪及城市环境地质问题等论文7篇;第6篇:地质旅行路线指南,介绍了河南省境内的供三十届国际地质大会野外地质考察的T335、T337、

T395 三条路线的概况和考察要点。刊登的文章在某些领域里,如钼矿、金矿的勘查与开发利用方面已处于国内领先水平,在国际上也是闻名遐迩的。因此,《文集》基本反映了近年来河南地质矿产行业主要方面的最新科研成果与学术水平。《文集》的出版对积累和传播地质矿产科技成果,进行学术交流,开展地质找矿,将发挥积极的促进作用。同时,也便于国内外地质界更多地了解河南地质科学发展的成就和特色。

《文集》是在河南省地矿厅厅长、河南省地质学会理事长张鹏远高级工程师和河南省地矿厅总工程师罗铭致教授级高级工程师的直接指导下完成的。参加审稿的有:温彦、杨文智、张克伟、吴国昌、潘泽成、彭万夫、刘长命、郭公民、金璠、郑德琼、王志宏等高级工程师。全书的编辑工作由潘泽成、彭万夫、刘长命、李瑞玲完成。英文译校由冯有利硕士和张克伟、王德有、陈铁华高级工程师担任;英文译审由中国地质矿产信息研究院的刘林群译审、张肇元译审、崔林沛研究员、程席法译审、贾跃明研究员承担。书前的河南省地质矿产图由河南省地矿厅区域地质调查队林德超、裴放高级工程师拟编;左爱萍、李潇丽清绘完成。全书的校对工作由潘泽成、彭万夫、刘长命、李瑞玲、冯有利、张克伟、王德有、陈铁华等同志担任。插图清绘由付洛玲、林世芳两位工程师完成。藉此《文集》出版之际,编委会仅向所有作者、所有对《文集》出版付出了辛勤劳动和给予支持与帮助的同志致以诚挚的谢意。我们还要感谢中国环境科学出版社对本书出版给予的大力支持与帮助。

《文集》编撰过程中编者对文稿作了少量删节或补充修改,并反馈给有关作者。囿于时间仓促,并受资料 and 水平限制,疏漏和贻误之处,敬请指正。

《河南地质矿产与环境文集》编辑委员会

1996年3月

INTRODUCTION

Henan Province is located in the middle of East China. The geographical position of it is in the middle and lower reaches of the Yellow River. Most part of the province is in the south bank of the Yellow River, so it is known as "Henan". Henan is one of the birthplaces of Chinese ancient civilization, here ancient human beings lived and multiplied one million years ago. The agriculture, animal husbandry and ceramics occurred here early in the Peiligang cultural period seven thousand years ago. The abbreviated name of Henan is "Yu", for Henan was once the place of "Yuzhou" which was located in the middle of the ancient nine prefectures, so from which the name of "Zhongzhou" and "Zhongyuan" derived. The geographical position of Henan is situated between latitudes $31^{\circ}23' \sim 36^{\circ}23'N$, longitudes $110^{\circ}21' \sim 116^{\circ}39'E$. Henan is 580km in length from east to west and 530km in width from south to north, its area is $1.67 \times 10^5 \text{ km}^2$ and the population is 90.27 million. Henan extends across warm temperature zone and north subtropic zone, belonging to continental monsoon climate area, with sufficient illumination, moderate rainfall and obvious four seasons. The annual rainfall is between 600~1,000mm from north to south. The terrain relief is higher in the west and lower in the east in Henan Province. The province is surrounded by Taihang, Funiu, Tongbai and Dabie Mountains in the north, west and south respectively. The altitude of Taihang and Funiu Mountains is above 1,000m generally. The Laoyacha in Lingbao County is the highest point in Henan Province, it is 2413.8m in height. The eastern part of Henan is alluvial Yudong Plain, which is part of the Great North China Plain, its altitude is below 100m. A. S. L. .

The characteristics of geology and mineral resources in Henan Province are as follows : gathered-together strata from northern and southern China , multiplsuperimposed structure, frequently activated magmatism, excellent metallogenetic factors and rich in mineral resources. (details see "Map of geology and mineral resources of Henan Province"). There are 160 sorts of minerals which have been utilized in the world at present, among them 132 sorts have been discovered in Henan and more than 90 sorts of minerals have been exploited and utilized. The reserves of minerals such as molybdenum, trona, blue asbestos, perlite, kyanite, molding sand rank first in China. The coal, natural gas, aluminium, gold, silver minerals are dominant mineral resources, their reserves stand in the forefront in China. The nonmetallic minerals such as cement material, fireclay, granite, jade and rock salt etc. are rich and have bright prospects. According to the statistics, the reserves of 50 kinds of minerals in Henan occupy first ten place and 16 kinds of which rank first three in China. The average annual natural surface-water resources and annual total amount of groundwater resources of Henan are 31.3 billion m^3 and 20.4 billion m^3 respectively. At present, there are 2,300 mineral oc-

currences, 250 state-owned large or medium-scale mine enterprises and more than 4,600 county or town-owned mine enterprises in Henan province and it has already taken shape in mineral exploitation and utilization. Now, Henan has become one of the important producing areas for energy, nonferrous metal, precious metal and nonmetal material in China. Not less than thirty sorts of mineral products have been exported to more than thirty countries and districts, such as Southeast Asia, Japan, Europe and America.

The 30th IGC is an olympian grand meeting in international geological circles. In order to introduce the general situation of geology and mineral resources of Henan Province, reveal the new achievements of geological research and survey in the nineties and develop international scientific exchanges, implement the reform and open policy and vitalize the economy of Henan Province, the Department of Geology and Mineral Resources of Henan Province (HGMR), Henan Bureau of Geoexploration and Mineral Development, MGMR, and Geological Society of Henan decided to publish this collected works of *Contributions to Geology, Mineral Resources and Environment of Henan Province*, abbreviated as *Contributions* hereinafter, dedicated to the 30th IGC holding in Beijing.

The *Contributions* includes 44 scientific theses about Henan geology, mineral resources and environment, and three field trip guides (summaries) prepared for the 30th IGC. Each paper has an detail abstract in English attached to it. This book is divided into six parts with 0.5 million words or so. The first part is about regional geology including thirteen papers on petrology, geochemistry, stratigraphy, sedimentology, lithofacies and paleogeography, paleontology, and geotectology; The second part has eight theses about geology of ore deposits including gold, silver, aluminium, lead-zinc, kyanite, sillimanite, andalusite and coalbed methane; The third part is about exploring technology including ten theses on drilling, chemical analysis, geophysical exploration, mathematical deduction and application of structural feature and controlled blasting technique; The fourth part is about mineral development including six papers on gold ore dressing and leaching, jade processing and utilization of coal-mining gangue; The fifth part is about water resources and environmental geology including seven papers on water resources evaluation and development, flood-control for the Yellow River and urban environmental geology; The sixth part offers field trip guides of T335, T339 and T395 for the 30th IGC. The academic levels of some papers printed in this book rank leading positions in China and well-known in the world in some extent, for example, exploration and development for Mo and Au deposits. Thus, this *Contributions* reflects the newest scientific achievement of geological exploration and mineral development in Henan in recent years. The publishment of the *Contributions* will bring advantages to accumulate and spread scientific achievements in researches on geology and mineral resources, promote academic exchange, give great impetus to the geological exploration. Furthermore, it is convinient for geology circles at home and abroad to understand the achievements and specialities of geological sciences of Henan.

The *Contributions* has been edited under the direction of Senior Engineer Zhang Pengyuan—chief of the Department of Geology and Mineral Resources of Henan Province and chairman of the Geological Society of Henan, and Senior Engineer (Professor) Luo Mingjiu—chief engineer of the Department of Geology and Mineral Resources of Henan Province. Senior Engineer Wen Yan, Yang Wenzhi, Zhang Kewei, Wu Guochang, Pan Zecheng, Peng Wanfu, Liu Changming, Guo Gongmin, Jin Fan, Zheng Deqiong, Wang Zhihong went over the manuscripts. The editors include Pan Zecheng, Peng Wanfu, Liu Changming, Li Ruiling. Master Feng Youli and senior engineer Zhang Kewei, Wang Deyou, Chen Tiehua checked the English abstracts. The English language examination and revision was accomplished by Professor Liu Lingqun, Zhang Zhaoyuan, Cun Linpei, Cheng Xifa and Jia Yaoming from Chinese Institute of Geology and Mineral Resources Information. The map of geology and mineral resources of Henan Province in front of the papers was designed by Senior Engineer Lin Dechao and Pei Fang from Regional Surveying Party, HGMR; and then Zuo Aiping, Li Xiaoli traced it clear. The proofreading for press was undertaken by Pan Zecheng, Peng Wanfu, Liu Changming, Li Ruiling, Feng Youli (English), Zhang Kewei (English), Wang Deyou and Chen Tiehua (English). The charting of the illustrations was completed by Engineer Fu Luoling and Lin Shifang. At the moment of this *Contributions* publishing, the editorial board shows heartfelt thanks to all authors, all who gave hardworking and help to this book. We also express our cordial gratitude to Chinese Environmental Press for it sparing no effort to support the publishing of the *Contributions*.

The editors have slightly abridged or modified the manuscripts and feedbacked them to the authors during compiling. There must be some oversights and omissions in this book, please oblige us with your valuable comments.

Editorial board of *Contributions to Geology,
Mineral Resources and Environment of Henan Province*

Mar., 1996

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